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WHAT'S NEW IN INTENSIVE CARE

The paracetamol challenge in intensive care: going green with paracetamol

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Environmental impact of medication

Paracetamol is one of the most widely prescribed medications in critically ill patients [1]. Our intensive care unit (ICU) administered 50.133 g of paracetamol in 2023 (16.230 intravenous [IV] doses, 33.825 oral doses and 78 rectal doses). Two reports from the Netherlands showed that medication accounts for 40% of the environmental CO_2 footprint [2, 3]. Given this high percentage, interventions that decrease the administration of medications result in a direct decrease of the environmental footprint of healthcare.

Environmental impact of paracetamol

Davies et al. [4] performed a life cycle analysis and calculated the CO_2 emissions (CO_{2e}) of different formulations of paracetamol, including the administration supplies. They showed that the total life-cycle greenhouse emissions stemming from administering a 1 g dose of paracetamol was 38 g CO_{2e} for an oral tablet (from a blister pack) and 628 g CO_{2e} for an IV dose (from a glass vial). This shows a 16-fold increase of emission with the IV administration compared to the oral administration.

Patient perspective

From a patient perspective, IV and oral paracetamol have equal effectivity [5]. Although these data concerned a small group of patients, the high bio-availability and fast mode of action of paracetamol support its oral use in the majority of patients. Still, the pro's and con's need to be considered, especially if the patient is not absorbing enteral feed, if oral intake is not possible or in case of haemodynamic instability (IV paracetamol induced hypotension) [6].

The paracetamol challenge

In March and April 2023, we discussed the use of paracetamol IV in our green team, since is it our first line analgesic and is it part of our standardized admission medication set. Data from those two months showed that 42% and 55% of the paracetamol administrations respectively were given intravenously. Patient admissions and length of stay in those months were representative for the ICU.

We decided to start a paracetamol challenge. We designed a poster showing the waste of paracetamol comparing IV (1 glass bottle of 1000 mg = 100 ml) versus oral (2 tablets in a blister). We also challenged the medical team to decrease the amount of IV paracetamol with 25%. Together with the emergency department, we made a short movie in August 2023 and posted this movie on the intranet and on LinkedIn, challenging other hospitals in the Netherlands [7, 8].

The environmental impact of the intravenous to oral challenge was shown in our poster as grams of waste, because at that time there were no CO_2 emission data. One gram of IV paracetamol resulted in 146 g of waste and one gram of oral paracetamol resulted in 5 g of waste. We also showed the difference in price (1,89 Euros (€) for 1 g IV versus 0,07 € for 1 g oral). In our movie we created awareness about the procedures that need to be followed for administration of IV medication and the products that are needed in this procedure (IV access, use of infusion pump, IV-line, disinfectant, NaCl 0.9% flush, gloves use, etc.) and we explained the environmental impact.

Within a couple of days, more than 40 hospitals (out of 72) replied that they were willing to start the challenge. We decided to design a big paracetamol tablet with a diameter of 1 m, that could travel from hospital

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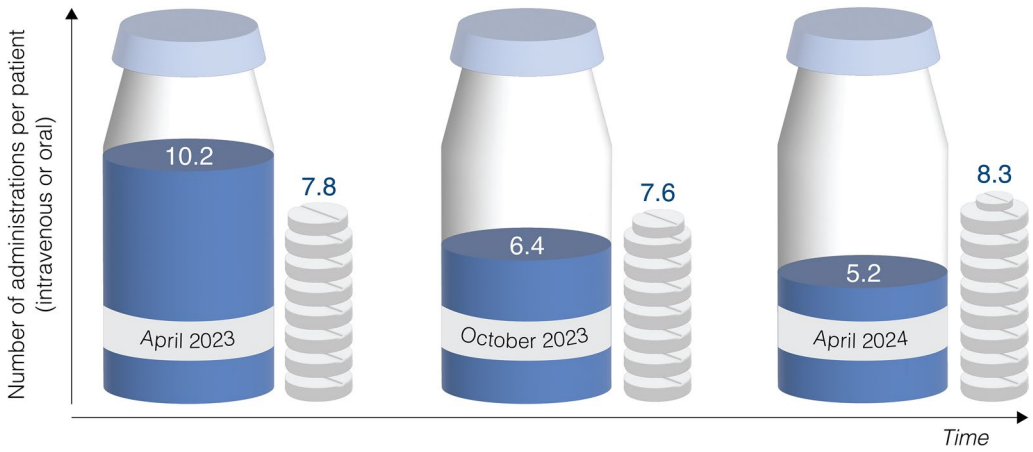

Fig. 1 Intravenous and oral paracetamol administrations per intensive care unit patient over time. Administration is defined as the number of doses of 1000 mg of paracetamol (intravenous or oral).

to hospital to inspire and motivate other hospitals (see supplementary Fig. 2). Again, we posted this message (November 2023) on LinkedIn with the hashtag *#paracetamolchallenge*, boosting others in joining and fulfilling the challenge.

Follow up data

In April 2024 (6 months after the start of the challenge) the tablet has travelled to 6 hospitals and 2 are awaiting the tablet. These hospitals all fulfilled the challenge and showed a decrease of IV paracetamol use of at least 25%.

Our own data show that the amount of intravenous paracetamol administrations in the ICU decreased from 10.2 IV administrations per patient in April 2023 to 5.2 in April 2024. This is a decrease of 49%. This saved the ICU 730 administrations of IV paracetamol in April 2023, resulting in 106 kg less waste, cost savings of 1.380 euro and a reduction 458 kg CO_2 emission (Fig. 1).

Measurements of IV paracetamol in August, September and October 2023 showed a decrease to 5.8, 6.4 and 6.4 administrations per patient (43%, 37% and 37% decrease).

Due to the IV oral switch, the oral administrations increased from 6.7 administrations of 1 g in April 2023 to 8.3 administrations in April 2024 (increase of 24%). Measurements of oral paracetamol in August, September and October 2023 showed an increase to 7.0, 6.1 and 7.6 administrations per patient (5% and 12% increase in August and October and 10% decrease in September). The overall increase in oral paracetamol administration was lower than the decrease in IV paracetamol, showing that paracetamol was less frequently prescribed. We consider this as an additional positive result of the challenge.

One could argue that the switch from IV to oral could have an impact on the pain scores. Unfortunately, the impact on pain experienced by patients was not studied. This is a relative shortcoming and would be interesting for follow up.

Impact for the hospital

On an annual basis, Erasmus University Medical Center (MC) administers a total of 40.000 IV doses of paracetamol. If all departments fulfill the challenge, this would result in a decrease of 10.000 IV administrations in Erasmus MC. This equals 1430 kg of waste, 6200 kg of CO_2 and 18,200 € as potential savings.

Supplementary Information

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Data availability

Data are avalaible on request.

Declarations

Conflicts of interest

NH declares she received a national grant from NWO (Dutch Research Agenda) involving circular hospitals. DT has nothing to declare. DG declares he received speakers fee from a speakers office regarding the topic of COVID-19.

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